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# CONTAGIOUS ABORTION IN COWS.

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INTRODUCTORY NOTE.—Frequent applications to the Agricultural Experiment Station of the University of California for information concerning contagious abortion in cattle, indicate that the disease is a serious one in California, as is true in other dairy regions of the United States and Europe. In response to these frequent demands for aid, the following article, by an acknowledged eminent authority, is presented. The Agricultural Experiment Station is deeply indebted to Dr. Law for his generous permission for the reprinting of this product of his pen. The control of contagious abortion is a troublesome matter, requiring the exercise of numerous precautions, the neglect of any one of which may nullify all previous efforts. Dr. Law has achieved marked success, by the methods to be hereinafter mentioned, among animals quite closely restrained as in the dairies of New York State. The article was written with reference to Eastern conditions, and doubtless some of his suggestions may require considerable modification to fit California practice.

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## FORMS OF ABORTION.

Cows are liable to abortion from a great variety of causes, some of which, like mechanical injuries, are purely individual to the animal and show little tendency to extend to other members of the herd. Other forms attack a considerable proportion of the herd at the same time, or in succession, and thus appear as if they partook of a contagious character. In many such cases, however, the implication of a number of pregnant cows in the same herd is only a common result of a special injurious condition, to which all are alike exposed, and the removal of this is the signal for the disappearance of the disease. Thus unwholesome food of all kinds which undergoes fermentation in the first stomach, causing the accumulation of gas (bloating), will at times cause a widespread abortion. The consumption of ice-cold water usually stimulates the womb to contraction and the unborn calf to active movements, which can be easily observed in the right flank. This, frequently repeated or carried to excess in susceptible animals, will at times cause

abortions. The consumption of irritant vegetables, which have a special tendency to act on the kidneys or womb, are causes of general abortions in herds.

Ergoted grasses have long been known as causes of abortion, and the same remark applies to smut and several other fungi. It is true that these cryptogamic vegetable products vary much in their character and strength according to the variations of the season and the local conditions under which they grow, as well as the time or stage at which they are harvested, so that the ergots and smuts of one year appear to be comparatively harmless, while those of another year or season or locality are very injurious. The fact remains, however, that under given conditions of growth they are unquestionably causes of abortion, and in such cases the abortions are widespread in the herd or in different herds in the same district. Cases such as these are easily mistaken for contagious ones, though there is in the system of the aborting animal no self-propagating germ which would produce the disease if transferred to another animal.

Still other conditions may produce widespread abortions in the absence of any specific contagious germ. On the magnesian limestones of New York, cows are very subject to small stones in the kidneys during the dry feeding of winter, and when this is added to other existing causes, like the riding of cows in heat, attacks made with the horns of their fellows, squeezing in half-closed gates, over-driving, sloping stalls, or too laxative food, abortions are likely to be induced. In other susceptible animals the proximity to a slaughter-house, the sight and smell of dead carcasses, or carrion, etc., will excite a pregnant cow to abortion.

*The Contagious Form.*—Any of the usual causes of sporadic or accidental abortion may co-exist with the true contagious element and give unusual energy to it, yet it is of the utmost importance to identify the contagion in all cases in which it is present as the essential cause. This can usually be done by a careful inquiry into the history of the outbreak.

When a herd has been continuously healthy up to the time of the introduction of a cow brought from a herd where abortion has been prevailing, and when, following her advent, one and another and another of the original numbers of the herd abort, without any apparent cause in the way of change of feed, water, barn, stalls, or general management, the evidence of the introduction of the element of contagion by the cow in question is very circumstantial and forcible. If pregnant cows standing next to the new cow, or near to her, are among those that early abort, the argument for contagion is still further corroborated. If the trouble continues in the herd year after year, attacking fresh animals some months after purchase, the case becomes still stronger.

Or take another case. A cow is sent from a herd to be served by a bull which has been allowed to serve an aborting cow, and her resulting pregnancy is terminated by abortion before the regular time, and this is followed by successive abortions by different animals in the previously healthy herd. Upon the face of it, an outbreak of this kind is manifestly contagious, and in the absence of any other appreciable cause for the trouble, it may be safely held to be so.

Or, a bull is brought from a herd where abortions have taken place, and after his arrival the cows begin to abort, the first cases being in those which the new bull has served. The occurrence is manifestly due to contagion.

Or, a newly purchased cow aborts and is disposed of in consequence, and another cow, placed in the same stall, in due time aborts also, and others follow in due time, especially those that stood next to or near to this stall. Everything points to an introduced contagion.

Such indications might be varied indefinitely; all variations, however, having the one thing in common, that the evidence of infection stands out prominently and unmistakably. The infection may have been evidently carried by the tail, tongue, soiled stall, litter, gutter, rubbing post, fence, or other object, yet the fact of contagion can be demonstrated with reasonable certainty.

These conclusions have been repeatedly affirmed by actual experimental transmission. The Scottish Abortion Commission found that healthy, pregnant cows often escape, though standing near to an aborting cow, but that when a piece of cotton wool was inserted in the vagina of the aborting cow for twenty minutes, and was then transferred to that of the healthy one, the latter invariably aborted. Galtier found that the infecting vaginal mucus of the aborting cow, when transferred to the same passage in other animals, caused abortion in the sow, ewe, goat, rabbit, and guinea-pig; whilst if it was intensified by passing through the rodents, it would similarly affect the mare, bitch, and cat.

Bang subjected two cows, which were three months pregnant and had come from healthy herds, to repeated vaginal injections, with the products of culture of the abortion bacillus in serum-glycerine-bouillon. Three injections were made on April 14th, May 23d, and June 4th, and on June 24th one cow aborted. The other was ill, and when killed she was found to carry a dead foetus. Pure cultures of the abortion bacillus were found in foetal membranes and liquids of both animals.

*Casual Infections.*—In a case which came under the observation of the writer recently, a family cow, kept in a barn where no abortion had previously occurred, was taken for service to a bull in a herd where abortion was prevailing, and though she was only present at the latter place for a few minutes, she aborted in the sixth month.

Another cow, from the same aborting herd, was taken into another herd at a distance of about two miles, and where abortion had been unknown up to that time, and some months later a cow standing in the next stall to her aborted. The remainder of this herd was sold soon after, so that the further progress of the disease could not be easily followed.

Jansen, as quoted by Sand, reports the case of a cow from an aborting herd having been taken into a herd that had been previously quite free from the disease. Soon after her arrival she aborted, and later cow after cow of the original herd aborted. The owner kept the matter secret, and sent his cows to a neighbor's bull for service, with the result that for two years abortion prevailed among cows served by this bull.

Tobiassen quotes the case of a cow in an aborting herd, which calved a fortnight before the regular time. The calf was at once sent to another farm where no abortions had occurred, and placed in the same building with the pregnant cows, all of which later aborted. The outbreak thus started lasted for several years.

J. R. Jansen reports that a cow brought from an infected farm, for fattening purposes, proved to be pregnant and finally aborted, and that twenty-four of the pregnant cows on the farm aborted in the same year.

Mörck reports that a cow which had aborted a fortnight previously was taken to a farm where abortions had never been known. She aborted during her next pregnancy, and so did all of the herd, nine in number.

Christensen records the occurrence of a general abortion in a previously healthy herd, members of which had been sent for service to the bull of a neighboring aborting herd.

Uygaard reports that a bull from a healthy herd, but which had been allowed to serve some cows from a neighboring infected herd, was sold to go on a previously healthy farm, where he was put to fourteen cows only. Of these, twelve aborted; while the other cows, served by another bull, remained well.

Cases like the above are not to be explained by some imaginary unwholesome conditions of the environment, since in every instance the surroundings of the animals and the conditions of life remained the same, and the only appreciable cause of the outbreak in every case was the contact with an animal from an aborting herd.

*Experimental Infections.*—Any possible doubt, however, may be removed by the cases of experimental transmission of the disease, by the transference of the mucus from the vagina of an aborting cow to the vagina of a healthy pregnant one. The experiments of Bang have been already quoted.

The Scottish commission (Woodhead, McFadyean, and Atkin) took

a pregnant cow from a healthy herd and placed her in a stable where a large number had aborted. They also inserted into the vagina of this cow a plug of cotton wool, which had been left for twenty minutes in the vagina of a cow which had recently aborted. This was repeated the next day, the plug being left in the vagina for several hours on each occasion. Within a month some indications of a threatened abortion showed themselves, and a seven months' calf was dropped on the seventieth day after the inauguration of the experiment.

In a second experiment, a cow six months in calf and taken from a healthy herd was placed in a stable with an aborting herd and a quantity of vaginal mucus from a cow which had recently aborted was injected under the skin of the vulva. She calved prematurely at the end of the eighth month.

Williamsen when treating a herd for abortion took a piece of the after-birth of an aborting cow and rubbed it on the vagina of a healthy cow of his own, which had a habit of carrying her calf fourteen days overtime. Five days after she had premature parturition. He took a fragment of the foetal membrane from the cow just named and rubbed it on the vagina of a pregnant cow, condemned to slaughter for tuberculosis. In seventeen days the cow aborted.

*Abortion Germ.*—A number of investigators have sought assiduously for the germ of abortion. More than twenty years ago Franck attributed the disease to *loptothrix vaginalis*, a spherical organism united in chain form.

The Scottish Abortion Commission isolated no less than five different bacteria from the abortion membranes and vaginal mucus, but failed to identify any one of these as the essential cause of the disease.

Nocard found in the fibrino-purulent matter between the chorion and womb, in aborting animals, two different organisms, a micrococcus (globular microbe) isolated or united in chains of two or three, or more, and a short, thin bacillus (rod-shaped microbe) isolated or attached together in pairs. These he did not find in healthy pregnant cows. They seemed to have no evil influence on the animal in the intervals between pregnancies, so he concluded that they caused disease of the foetus and foetal membranes alone and did not affect the womb of pregnant animals. He allows, however, that the germ can survive in the unimpregnated womb until the next pregnancy, and may thus be kept up for years in the same animal.

Galtier, on the other hand, has conveyed the disease by feeding and inoculation of the milk or abortion membranes, to the sheep, goat, pig, rabbit, and guinea-pig, and claims accordingly that the disease is one affecting the general system of the pregnant animal and that the germs can be conveyed through the blood to the womb. He claims that the

germ is intensified in force by passing through the body of the rabbit or guinea-pig, and can then infect horses, dogs, and cats.

Chester, of the Delaware College Agricultural Experiment Station, found in the placenta of aborting cows a bacillus, which in form and habit of growth closely resembled the common bacillus of the large intestine (*Bacillus coli communis*). In the fermentation test, however, it showed a marked difference from the colon bacillus, to which it seems to be so closely allied. Inoculated on rabbits it was not fatal. Injected into the vagina of a pregnant cow, it caused slight discharge for four or five days, but the calf was carried to full time—six and one half months after the injection.

Bang found in aborting cows, between the womb and the foetal membranes, a considerable odorless liquid exudate of a gelatinoid appearance, and some pus cells. There was active catarrh of the mucous membrane of the womb, which continued after abortion and often maintained the disease into the next pregnancy. In the exudate was an abundance of very small bacilli, which stained deeply with aniline colors, excepting in a vacuole or nucleus which was less highly colored. This bacillus grew well in serum-glycerine-bouillon, and more sparingly in serum-gelatin-agar. In the latter, it showed a remarkable peculiarity in growing with special luxuriance in different zones at two separate depths, beneath the surface, while there was an intervening clear space in which little or no growth took place. This preference for two different grades of abundance of atmospheric air and rejection of the intervening grade serves to identify the bacillus in a very striking manner. Injected into the vagina in two pregnant cows from healthy herds it produced abortion in one on the twenty-first day, and death of the calf without prompt abortion in the second. It also induced uterine catarrh and abortion in ewes, rabbits, guinea-pigs, and mares, when it was injected into the vagina. In several cases in which it was injected under the skin or into the veins, it was later found in abundance in the interior of the womb and the foetal membranes and bowels of the foetus. It can therefore live in the blood and pass from that to the womb to start its baneful work there.

Dr. V. A. Moore and the present writer have made a series of experiments at the New York State Veterinary College. We have found in the foetal membranes and uterine mucus of a number of aborting cows, in different counties of the State, and situated widely apart from each other, a bacillus which in form and culture-experiments closely resembles *Bacillus coli communis*. This was nearly always found in pure cultures; in a few cases only were other microbes found, and these only such as are found in a healthy vagina. It was never found in the foetal membranes, nor in the mucus of the womb in cows which had come to the period of parturition in healthy herds. It agreed in most

respects with the bacillus found by Chester, but differed somewhat in fermentation tests. It differed also in being fatal to rabbits when inoculated on these animals. Injected into the vagina of three pregnant cows, it continued to live on its lining membrane, producing more or less catarrh and mucopurulent discharge in the different cases, yet all three carried their calves to the full time as judged by the forward condition of the teeth, one having calved on the 123d day, the second on the 167th, and the third on the 190th after injection.

The investigations at the Delaware College Experiment Station and the New York State Veterinary College indicate that the contagious abortion which was met with in the cows of these States is essentially different from the forms studied in Europe by Nocard and Bang, respectively. The facts that the same germ was found alone or, exceptionally, along with the normal microbes of the healthy vagina in the womb of every aborting cow, and that it was not found in the healthy cow which had calved at full time, and that the generative passages were the seat of a catarrh, alike in the cows that aborted and in those that were injected with cultures of the germ found in the womb of the aborting animal, are virtually all but conclusive that this microbe is the essential cause of the abortion.

The fact that abortion has not so far occurred in the pregnant cows injected experimentally with the artificial cultures of this germ, only serves to show that under certain conditions the microbe operates slowly. In our cases the cows were dry during nearly the whole course of the experiment, and stood quietly in stalls, so that there was little accessory cause to assist in precipitating abortion. It is further worthy of note that in the form of abortion habitually prevalent in New York, it is the rule rather than the exception that the period of incubation often extends to the sixth month. In a recent case which came under the observation of the present writer, and in which the cow contracted the infection by the service of a bull in a neighboring aborting herd, the abortion took place at the sixth month of pregnancy. In our experimental cases, it was certain that the same bacillus, which was alone found in the aborting womb and which was present there in great abundance, remained present in the generative passages of the infected animals up to the time of parturition and thereafter.

It is worthy of notice that the recent bacteriological investigations of the disease in Europe show that the pathogenic germ is present in large numbers in the digestive organs of the calf, that the new-born calf can convey the disorder into a fresh herd (Sand), and that the viable calves of infected cows are liable to die from intestinal disorders a few days after birth. Galtier, the Marquis de Poncius, and Pry insist strongly on this. On a farm on the estate of the Marquis, where abortion has prevailed for over twenty years, calves of infected cows show at birth or

very shortly after symptoms of broncho-pneumonia and of a complication of nervous disorders. They are breathless, wheeze, discharge from the nose, cough, scour, have convulsions and other nervous troubles. A large proportion of such calves die, and their lungs are found in part red, consolidated and destitute of air, while the air tubes contain a mucopurulent liquid. Lesions denoting inflammation of the pleural covering of the lungs, of the liver, and of the intestines are common.

This coincidence of a fatal disease in many of the surviving calves has not been specially noticed in the aborting herds in New York. Should it be found to be wanting or infrequent, it will establish still another distinction between the European abortions, as noticed by Nocard, Galtier, Bang, and others, and the American type, as observed in Delaware and New York.

In investigating this subject it must be borne in mind that any catarrhal condition of the mucous membrane of the uterus hinders conception, and becomes a direct cause of abortion, and that the forms of invasion of the womb by pus-producing germs are as numerous as the number of different irritant germs that can live in the membrane. The question as to how many of these may induce contagious abortion is to be determined by the susceptibility of the membrane to the attack of each particular germ, and whether the latter can retain all its power of survival and virulence in passing from one animal to another. The presumption is, therefore, in favor of a variety of forms of contagious abortion, each due to its own specific microbe or microbes rather than of a single unvarying type of the disease. It is the work of the future investigator to demonstrate the extent and nature of such variations, and to place the diagnosis and treatment of each on a substantial basis.

The indication that there are probably at least two forms of contagious abortion in cows raises the question whether both are to be found in our American herds, and, if not, whether there is not an urgent demand for such a rigid quarantine and inquiry into the condition of all imported cattle as will establish a reliable barrier against the more dangerous foreign disorder? No less important is it that we should recognize the presence of the more dangerous disease, if it should already have a foothold in American herds, and trace its cause, nature, and diagnostic symptoms, so that the treatment appropriate to each individual outbreak may be promptly and intelligently applied. The tens of thousands of dollars lost every year through the prevalence of contagious abortions in the dairy herds of New York would justify a liberal outlay to establish our knowledge and practice on a rational and scientific foundation. In Europe the loss on each aborting cow is set at from \$12 to \$25 per annum.

*Do the Same Animals Abort Several Years in Succession?*—The question of persistent abortion, year after year, by the same cow, is one of



far-reaching importance. If a first contagious abortion entails a second, a third, a fourth, and a fifth in the same animal, in as many successive years, then manifestly her preservation is a mere squandering of money, apart from the danger of her transmitting the disease to other and healthy animals. If, however, on the other hand she herself fails to abort the second or the third year, yet if she continues to carry in her generative passages the germs of the malady, as potent as ever for evil to other pregnant cows, her preservation in her present condition is a hidden source of the infection, that can still spread from her to all new and susceptible cows which may be added to the herd.

It was long supposed that repeated abortion for an indefinite number of successive years was inevitable in the animal which was once infected. There is no doubt that certain cases give color to this belief. In an organ so nervously susceptible as the womb, there is always a tendency to repeat the abortion under the stimulus of a new pregnancy and the gradual distension and development of the uterine walls. Yet statistics show that this only applies to a small proportion of cows, and these the most excitable and nervous. The tendency toward insusceptibility to the deleterious action of the germ, which still may be present, is in the cow greater as a rule than the disposition toward a nervous increase of the susceptibility. The difficulty in reaching a conclusion on this point depends on the fact that stock-owners very commonly dispose of aborting cows, and as the freshly bought cows are sooner or later attacked, it is too confidently assumed that the old cows, too, would have aborted had they been retained. Many years ago observant New York dairymen had noticed that the same cow rarely aborted over three years in succession and the majority not over two. Quite recently the owner of a large herd, who had had much experience with the disease, assured me that the rule was that a cow did not abort a second time. The continuance of abortion in the herd was mainly among newly purchased cows, and others that had not been previously attacked. The same is measurably true of the European abortions. Nocard says that after three to five years there is an acquired immunity. Penberthy says that in case of repeated abortion in the same cow, the calf is carried longer each successive year until it comes to its full term. Sand, in his symposium of the experience of Danish veterinarians, says it is quite exceptional that a cow should continue to abort, but outbreaks of abortion disappear spontaneously if no new cows are brought in.

In the main this is indorsed by the experience of Bang. In a herd of two hundred head, in the course of several years, eighty-three aborted in their first pregnancy, and of these only twenty aborted in the second, and seven failed to breed. Counting these latter as having aborted, this amounted to less than one third, while over two thirds of the cows

which aborted the previous year carried the calf the full time. In the herd, only thirty aborted for two successive years, and only six for three years running.

Paulsen quotes the case of a herd of sixteen, seven of which were sent for service to a bull in an aborting herd. All seven aborted: five at ten weeks, one at three months, and one at four and a half months before the normal period of parturition. One of the seven was sold, but the remaining six went full time in the following year.

Mörck records the case of a herd of sixteen cows, of which the majority aborted the same year. The owner disposed of all the aborting animals and replaced them by others freshly purchased. Next year the new stock aborted, together with some of the cows that had been held over. He continued this course for eight years without any improvement, and then decided to keep the aborting cows, as well as the others. In two years the affection disappeared from the herd.

Such small herds, in which all become early infected, and in which there are not yearly additions of young animals in their first pregnancy, nor the opportunity for a continuous extension into new animals that have previously escaped infection, furnish a better opportunity than do the larger herds, to trace the acquirement of artificial immunity.

#### PREVENTION AND TREATMENT.

Admitting the frequency of acquired insusceptibility, we have to guard more against repetition of abortion in the same cows. To protect the new stock against infection, however, it becomes necessary to purge from the infection all cows which still harbor the germ in their generative passages, though they do not themselves any longer abort. It also becomes necessary to guard against infection through stalls, bulls, etc., from such infected, but no longer aborting, cows.

The following was written with reference to conditions in New York State, and portions of the suggestions are inapplicable to cattle upon the ranges in California.

Upon the following there can be no dispute:

*First*—The cow which shows symptoms of abortion should be at once removed from the others, and her stall, including the gutter and drain leading from it, thoroughly disinfected.

*Second*—Every cow which has aborted should be instantly removed from the stable into a separate building, and her stall, with its gutter and drains, thoroughly disinfected.

*Third*—The aborted foetus, with its membranes, should be at once removed and burned or boiled, or deeply buried after it has been sprinkled with chlorid of lime or other active disinfectant.

*Fourth*—The manure from the infected stable should be taken into an inclosure to which no cows have access, and freely watered with a solution of sulfate of copper (one ounce in one quart of rain water).

*Fifth*—The cow which has aborted, and those standing on each side of her, should have the external generative organs, the adjacent parts of the thigh, and the whole length of the tail sponged every morning with the solution of one ounce of sulfate of copper in one quart of water.

*Sixth*—The cow that has aborted or is suspected of abortion, and which has been isolated from the herd in a special stable, should have its stall carefully cleaned, scraped, and watered daily with the sulfate of copper solution. Her manure and urine must be carefully disinfected, as provided above.

*Seventh*—In case that more than one animal has aborted in a herd or stable, it is desirable to sponge the external generative organs, hips and tails of the whole herd daily with the sulfate of copper solution, and to disinfect the hind parts of the stalls, the gutter, and the drains every morning, as prescribed above.

*Eighth*—Further to prevent the introduction of the infection into a herd, all newly-purchased cows should be put at first in a separate quarantine stable, and be subjected to daily disinfection of the external parts, and the stalls. As each cow comes in at full time, and without any further indication of disease, she may be transferred to the stable occupied by the general herd.

*Ninth*—In purchasing a bull the greatest care must be taken to see that he comes from an absolutely sound herd, and that he had not been allowed to serve cows from a herd where abortion exists. It is a safe precaution to wash his sheath with the disinfectant liquid and to inject it freely with the same before beginning to use him in the herd. He should be allowed to serve no cows from outside the herd, unless it can be shown that they are from herds that are absolutely free from abortion.

By a rigid application of the above measures the extension of contagious abortion in a herd can be certainly prevented, and the rule being that the majority do not abort a second time, the disease can in this way be got rid of.

It must be borne in mind, however, that in an infected herd there will always be a certain number of pregnant animals, in which the germ is always lodged deeply in the vagina and even in the womb, and these measures can not prevent the occurrence of abortion in their cases. There is also the danger in a certain limited number of those which have a tendency to abort a second time, that the germ will continue to live throughout the following year in the interior of the womb, and not only cause another abortion in the individual cow, but start the infection anew in other members of the herd.

There is some danger of such survival even in a cow which has become herself immune so that she will carry her calf to full time and yet infect other susceptible cows which may be exposed more or less directly to her discharges. It is for such cases that medication by the mouth and injections into the vagina or womb have been resorted to.

*Tenth*—Among medicines used to check abortion by acting on the general system are viburnum prunifolium and potassium chlorate, which can hardly be upheld as disinfectants, but act only on the nervous system or on the general health. Carbolic acid, one of the latest fads, is employed, on the other hand, with the intent of checking the propagation of the contagious element. Diluted in water so as to be non-irritating, it has been injected daily under the skin, for a length of time and with alleged good results. It is noticeable, however, that when the good effects have been apparently most constant the animals have at the same time been subjected to very careful and continuous external disinfection, which in itself is amply sufficient to account for the favorable applications, the results have been much less favorable. Thirty-seven Danish veterinarians employed it in ninety-two separate herds, with results that were apparently good in forty-seven cases, doubtful in twenty, and negative in twenty-five. Thirteen other veterinarians who have employed it extensively report the results as doubtful or negative. It is not surprising that a majority of these practitioners abandoned a method which in theory must be looked on as unpromising and which proved so uncertain in actual practice.

*Eleventh*—The other resort is *a priori* more promising, consisting as it does in the application of a disinfectant to the infected mucous membrane of the generative organs. The two agents most in use are carbolic acid and mercuric chlorid.

Carbolic acid, which is the less dangerous agent, is prepared by adding one troy ounce and a half of the acid to a gallon of water, together with a troy ounce of carbonate of soda. This is injected daily for a week, through a large syringe, or an elastic rubber tube introduced into the passage and having a funnel inserted in its outer end, which is carried two feet higher than the root of the tail. A quart may be employed at each injection and it should be used milk-warm.

The mercuric chlorid, the more poisonous of the two agents, is used in a solution of one drachm to the gallon of water, to which is added a drachm of hydrochloric acid. This is used milk-warm in the same way as the carbolic acid solution. This is very corrosive as well as poisonous, and must be kept in a wooden vessel, safely locked up from man and animals.

The writer has used such injections in aborting animals and herds, and at the same time with the daily disinfection of the external parts

of the generative organs, the stalls, gutters, drains, and manure, and with perfect success where it could be thoroughly carried out.

It is subject to the serious objection that it causes active straining when the injection is administered, and if this becomes extreme, it may create apprehension that it will precipitate abortion rather than obviate it. This has led Nocard and others to abandon the injections and to rely altogether on external disinfectants. For pregnant animals this is to be commended, as the disinfectant can not penetrate and disinfect an already infected womb, and is therefore not likely to prevent an abortion when the germ has already gained that cavity. In the cow that has just aborted, on the other hand, the danger of injury from this cause is reduced to the minimum, and the disinfectant injection, thrown into the depth of the womb itself, offers the only hope of a speedy disinfection of that cavity. The external application merely prevents the access of new germs from without, while those that are within are left to be destroyed by the unaided action of the lining membrane of the womb. That this action is usually slow is illustrated by the fact that abortion germs habitually live for a length of time in the vagina and womb, before producing abortion, and that they often continue to live there much longer unless preventive measures are resorted to. In the animal which has aborted some time before and which is still unimpregnated, injections are equally commendable. It may not be admissible in this case to introduce the liquid into the womb, but even if limited to the vagina, the resulting disinfection is highly advantageous in cutting off this source of renewed infection for the uterus, and placing the organ in a much more favorable position for the destruction of the bacilli which it contains.

*Conclusion.*—In conclusion, it may be stated that this subject still offers an extensive field for profitable investigation, and that we should not rest satisfied with the partial knowledge already attained, but push our inquiries in new directions when there is a good prospect of securing the means of a fuller, more perfect, and more easily available control of this great source of loss to our dairy interests. The form or forms of contagious abortion in our home herds should be fully investigated and the conditions of the life and propagation of the germs more definitely determined, and the same should be secured for other forms which may not as yet be indigenous to the United States, but which are likely to be introduced through the medium of importations. Our dairy industry is one of the most important of our sources of income, and a moderate outlay for an investigation which will render that safer and more remunerative, or which will protect it against threatened dangers from without, must prove an important measure of natural economy.

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